*Silver Edition* *Software Series*

# THE FLOPPY DOCTOR and MEMORY DIAGNOSTICS

by Dave Stambaugh

MODEL III



**Data Resources Corporation**

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THE FLOPPY DOCTOR / MEMORY DIAGNOSTIC -- MODEL 3 VERSION



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Computer professionals have long known the importance of regular use of diagnostic software in verifying the integrity of computer hardware. The TRS-80* is no exception; good diagnostics are a must in any situation where valuable data files are maintained. Recent advances in the use of double-density recording techniques stretch the hardware to its limits and make it even more important than ever to thoroughly evaluate the system prior to "trusting" it with your valuable data. THE FLOPPY DOCTOR / MEMORY DIAGNOSTIC are two programs designed to thoroughly evaluate the performance of your Model 3 in the two areas most likely to give you trouble -- the disk system (controller and drives) and the memory arrays. Both programs are written in Z-80 machine code and are supplied together on diskette for a minimum 32K single disk Model 3 TRS-80* computer system.

Every attempt has been made to make these diagnostics as complete and as thorough as possible. However, there is always the possibility that certain hardware problems in your system may escape detection by these tests. In particular, MOS memory problems can be especially difficult to find due to pattern sensitivity in some devices. In any case, these two diagnostics will provide you with a high degree of confidence in the integrity of your system.

LOADING THE PROGRAMS

The master diskette contains its own loader and CANNOT be read by any of your DOS software; there is no "system" or directory on it. To boot the loader, power up the system, put the master disk in drive 0, and press the "RESET" button at the right side of the keyboard. The screen will clear and you will be asked:

LOAD WHICH PROGRAM? (1=DISK, 2=MEMORY)

Select the test you want to run by pressing either "1" or "2". You will then be asked:

HOW MANY TRACKS ON DRIVE 0? (1=40, 2=80)

Answer this query with either 1 or 2, whichever is appropriate. The selected test will begin loading and in a few seconds will announce itself. The master diskette should be removed from the system as soon as the program finishes loading.

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THE FLOPPY DOCTOR -- MODEL 3 TRS-80* FLOPPY DISK DIAGNOSTIC



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THE FLOPPY DOCTOR is the most complete diagnostic program available for the Model 3 TRS-80* disk system, and could be the most important program in your software library. This program provides a positive means for thoroughly evaluating the disk controller circuits and disk drives of just about any Model 3 system configuration. Problems in the disk system can "hide" from the user since system DOS software will perform retries whenever errors occur; these errors may result in excessively long disk access times or as diskettes which can only be accessed in the same drive they were written on. In extreme cases, a diskette may prove to be totally unusable.

From one to four drives can be tested at the same time. Drives may have 35, 40, 77, or 80 tracks, any stepping rate available from the controller chip may be used, read/write compatibility between drives may be checked, and tests can be run continuously if desired to insure the long-term reliability of your system. Complete and detailed error messages will be reported when errors are detected, along with error totals for each drive at the end of each pass of the diagnostic. As the test progresses, the user will be provided with "positive feedback" as some of the individual checks are made. THE FLOPPY DOCTOR is a stand-alone program, not using or depending in any way on any DOS software.

There are ten separate tests which may be selected. Two of these tests (S & T) are special-purpose and not normally selected. The purpose of each test is summarized below; a more detailed description is given in the "Test Descriptions" section of the manual.

TEST A - Tests the most basic disk controller board functions and status lines; checks for proper operation of disk drive mechanical components such as track zero detector, write protect switch, and index pulse sensor.

TEST B - Verifies that data is being transferred from drive to controller; forces certain error conditions to see that they are correctly reported; tests disk controller interrupts and CPU wait-state generation.

TEST C - Performs a comprehensive test of the drive's ability to seek to all tracks without error.

TEST D - Performs a single-sector write/read. The data read back is verified byte-by-byte to insure correct and accurate data transfer to and from the CPU. If testing double sided drives, correct side selection is verified.

TEST E - Performs a write/read operation across the entire diskette. By writing alternating tracks of ones/zeroes, cross-track interference problems are checked.

TEST F - Performs a write/read operation across the entire diskette using an incrementing pattern (00 --> FF). Insures that the controller can handle any possible data byte written.

TEST G - Performs a write/read operation across the entire diskette using a

worst-case data pattern (5B) for MFM recording as used in the Model 3.

TEST H - Builds a table of 100 random tracks and sectors, then writes 256 random data bytes to these tracks/sectors and reads them back in reverse order.

TEST S - Tests the basic accuracy of the drive motor speed.

TEST T - Tech test; useful for performing alignment of drives or monitoring a write or read operation during system troubleshooting.

RUNNING THE DIAGNOSTIC

> ===> NOTE <=== RUNNING THIS PROGRAM REQUIRES THAT A FORMATTED DATA DISK BE INSTALLED IN EACH DRIVE TO BE TESTED. *DO NOT* USE DISKETTES WHICH CONTAIN PROGRAMS OR DATA YOU WANT TO SAVE -- **EVERYTHING** (DIRECTORY, DOS, DATA, PROGRAMS) ON THE DISKETTES WILL BE DESTROYED DURING THE TEST. DISKETTES MUST BE RE-FORMATTED WHEN YOU FINISH RUNNING THE TEST TO MAKE THEM USABLE AGAIN WITH YOUR DOS. *DO NOT* LEAVE THE MASTER PROGRAM DISK IN A DRIVE YOU ARE GOING TO TEST, AND *DO NOT* REMOVE THE WRITE PROTECT TAB FROM THE MASTER DISK!!!

After the program has loaded, you will be reminded to remove the master disk from drive 0; press "ENTER" when ready. You will then be asked to specify the desired operating parameters. When entering this information, if you accidentally make an incorrect response, enter " " (up-arrow) to restart the questions. In the following descriptions, "(EN)" denotes a question which may require the "ENTER" key to be pressed as the last character entered. All drives to be tested at one time must be capable of running under the same parameters; in other words, if you specify 40 track operation, ALL drives to be tested must have at least 40 tracks. If you have a mix of drives, you should test them separately. While the dianostic is running, you can terminate it at any time by holding down the "ENTER" key. In addition, at any time you are entering data from the keyboard, the up-arrow key will restart the program.

ENTER THE DRIVES TO BE TESTED? (0-3) - Enter up to four digits corresponding to the drives you want to test. For example, to test drives 0 and 1, you would enter "01"(EN). To test all drives in a 4-drive system, you would enter "0123" ("EN" not necessary after the 4th character in this case). Drives may be tested in any order (EXAMPLE: "3201" is legal).

HOW MANY TRACKS? (1=35, 2=40, 3=77, 4=80) - Enter the number of tracks for the drives under test. The standard Model 3 drives have 40 tracks, so you would enter "2". Please note again that the diskettes you are using MUST be formatted for the number of tracks you have specified here; trying to run the program on an 80 track drive with a diskette formatted for only 40 tracks will not work!

SINGLE OR DOUBLE DENSITY? (1=SINGLE, 2=DOUBLE) - If your diskettes are formatted in single density, enter "1"; if they are formatted in double density (which is standard TRSDOS* format), enter "2". THE FLOPPY DOCTOR makes

the assumption that if you specify single density, there are 10 sectors per track; in double density, there must be 18 sectors per track.

ENTER STARTING SECTOR NUMBER ON EACH TRACK? (0 OR 1) - Model III TRSDOS* numbers sectors from 1 to 18, so in that case you would enter "1". NEWDOS-80*, in its standard double density configuration, numbers sectors from 0 to 17, so you would enter "0".

SINGLE OR DOUBLE SIDED DRIVES? (1=SINGLE, 2=DOUBLE) - This option allows you to test both sides of a double sided drive as a single volume IF the disk is formatted in standard NEWDOS-80* double side format; sectors must be numbered the same on both sides of the diskette (0 to 17, 1 to 18, or whatever). Enter "1" for standard single sided operation, or "2" for double sided operation.

TK-TO-TK ACCESS TIME? (1=30 MS, 2=20 MS, 3=12 MS, 4=6 MS) - This option selects the controller's delay (in milliseconds) between stepping pulses during seek and restore operations. The standard Model 3 drives are rated at 5 MS track-to-track, so you would enter "4" since that is the fastest value available from the controller. For other drives, enter the value that is closest to but not less (faster) than their specs. If you don't know what the specs for your drives are, begin by using the slowest rate (30 MS). Try increasing the rate each time you run the test; if you begin to get seek errors during Test C, you have probably exceeded the capabilities of your drive.

TESTS? (ABCDEFGH,ST) - Enter the tests that you wish to run. Tests may be specified in any order, as many times as you want, up to a maximum of 50 total characters entered. For example, to run tests A and C, enter "AC"(EN). If you were to enter "FFGGDD", tests F, G, and D would each be run twice on each drive. One pass of the diagnostic consists of running all specified tests, in the order you gave them, on each drive. Please note that the tests (going from A to H) are more or less in ascending order of difficulty and that when testing a drive whose status is unknown, you should run them in order. In other words, Test B operates on the assumption that Test A will pass, Test C assumes that both A and B will pass, etc.

Test S is the motor speed test; entering "S" at any point while specifying which tests to run will cause immediate execution of the speed test on the 1st drive you requested.

Test T is the Tech Test. Its main purpose is for use in aligning and troubleshooting the disk system. Entering "T" at any time will cause immediate transfer to the Tech Test, exercising the 1st requested drive.

RUN CONTINUOUSLY? (Y OR N) - If you want the system to run the specified tests on a continuous basis, enter "Y". If you only want to run through them once, enter "N". It is not recommended that you run the test continuously for more than a couple of hours unless you can provide some means of extra cooling for the system, such as a muffin fan. The motors used in minifloppy drives are not designed for continuous operation, and could overheat if operated in this manner.

TERMINATE TEST ON EXCESSIVE ERRORS? (Y OR N) - This option provides for recovery from endless error looping. If answered "Y", all testing would be terminated after 10 errors of any type have accumulated. For example, the

diagnostic would terminate after 10 seek errors or 10 CRC errors. If this option is answered "N", testing would continue regardless of the number of errors accumulated. This option does not affect any part of Test A and B or portions of Test D where error conditions are forced or where errors in the operation of basic drive components such as track 0 detector would cause improper operation in all other tests. Such errors may be considered "fatal" and cause testing to be suspended.

OPERATOR INTERVENTION? (Y OR N) - Portions of Test A and the diskette interchangeability test require that this option be answered "Y". If this option is answered "N" the write protect and index detect functions are not completely tested. This option will always be automatically disabled after the completion of the 1st pass of the diagnostic when running continuously. See next option for more on this...

TEST DISKETTE INTERCHANGEABILITY? (Y OR N) - If the previous option was answered NO, this question is skipped. If operator intervention was specified, answering this option "Y" will allow the opportunity to test diskette compatibility between drives in a system when running tests E, F, G, or H. In these tests, the diagnostic will write data on a diskette and then prompt the operator to put the diskette in another drive where it then will be read for accuracy. If this option is answered "N", the read will be accomplished on the same drive as the write. Again, this option will be automatically disabled after completion of the 1st pass of the diagnostic.

After a diskette has been read-verified in a different drive, the program will prompt the user to put it back in its original drive. At this time, be sure to put ALL diskettes back in their original drives before continuing.

TEST DESCRIPTIONS

The following descriptions of each test in the diagnostic are somewhat technical by necessity. If you would like more information on how the Model 3 disk system works, you may want to purchase Radio Shack's Model 3 Technical & Service Manuals. For information on the 1793 disk controller chip, you may want to request the data sheets for that IC from Western Digital Corp., 3128 Red Hill Ave., Box 2180, Newport Beach, CA 92663.

TEST A - This test checks the most basic disk controller functions and for proper operation of components within the disk drives. A software timing loop will be entered to ensure that the motor timeout one-shot has expired; the drives should then be sensed "Not Ready". The drive is then selected, and should be sensed "Ready". Two Step-In commands are issued to guarantee that the head is not positioned outward beyond track 0 (a possibility on some drives). The controller is allowed to timeout again, and the operator is prompted to open the drive door and pull out the diskette 1/2 inch to prevent detection of an index pulse and to trip the write protect switch. The drive is selected again and these two conditions are checked. Another timeout occurs, and the operator is prompted to put the diskette back and close the door. The drive is then selected again; the controller should be detecting index pulses now, and write protect should not be sensed. A Restore command is issued to the controller chip; at this time the controller should be sensed "Busy" and the track 0 switch in the drive should have been tripped telling the controller that the head is in fact on track 0. The head is then stepped in once to track 1; track 0 should no longer be sensed, and the controller's

track register should indicate that we are on track 1. A step out command is given; the head should return to track 0, track 0 should be sensed, and the track register should = 0. This completes Test A.

TEST B - This test checks all interrupts associated with the disk controller, verifies that data is in fact being transferred from the drive to the controller, and attempts to force certain error conditions to insure that they occur when they expected. The drive is sent a Restore command (without read verification) and a Read Track Address command is then issued. After executing a timing loop, the controller DRQ (Data Request) bit should be on, indicating that data is coming in. Since the DRQ was not serviced in time, a Lost Data error should have occured. Next, the controller track register is loaded with a non-valid track number (the head still actually being on track 0) and a Read command is issued. This should cause a Record Not Found error. Motor timeout interrupts are now tested by selecting the drive, enabling this interrupt, and having the CPU execute a count loop until either the loop expires (error) or the interrupt occurs. Disk controller CPU wait states are checked using real time clock interrupts (assumed to be operating correctly!!). The real time clock is enabled, and the CPU then executes a loop that continuously enables wait states, and increments a counter. When the real time clock interrupt occurs, if the wait states were occuring as they should, the loop count will not exceed a pre-determined value since the CPU will be in a wait state for approximately 1 MS during each loop cycle. Finally, the disk INTRQ interrupt is checked during a specially controlled sector read operation. This completes Test B.

TEST C - This test checks the ability of the drive to properly position the head at any track on the disk. The first section of the test sets up two counters; counter A starts at 0 and increments while counter B starts at the highest track number and decrements. The seek commands are issued using complete read verification to insure that the head is in fact positioned correctly. This series of seeks will result in a damped oscillation across the disk, settling at midpoint. Next, a series of seeks is performed in the following sequence: from track 0 to 2, 2 to 1, 1 to 3, 3 to 2, etc. This is further insurance that the drive can position the head correctly under any condition. This completes Test C.

TEST D - This test will check the write and read commands by writing an alternating AA/55 pattern to the first sector on track 0. The sector will then be read back and the entire 256 byte buffer will be checked to insure that data is being correctly transferred between the disk controller board and the CPU. Errors caused either by controller status flags or by unexpected data returned during the read will be listed, showing the expected and actual data in hexadecimal form. If double sided operation was specified, correct operation of the side select control line is checked by writing the opposite pattern to the same sector on side 1; both sides are then read back to insure that the data is in fact unique, and that the controller is in fact talking to side 1 when it thinks it is. Under NEWDOS-80*, since sectors are numbered exactly the same on both sides of the disk, it is possible for the DOS to not know for sure which side it is looking at (try setting up PDRIVE for a double sided drive on an internal single sided drive, and format it -- you won't get any errors!).

TEST E - This test performs a write/read across the entire disk using alternating tracks of ones and zeroes; this is intended to test for possible

cross-track interference problems (writing on one track altering data on an adjacent track). This can be especially critical on 77 and 80 drives since the track to track spacing is much closer. Diskette interchangeability may be checked as described under that test option. Data transfer is done a single sector at a time with complete error checking after each transfer.

TEST F - This test performs a write/read across the entire disk using an incrementing pattern (00 to FF). This effectively checks that the controller and drive can handle any possible data byte value sent to it. Diskette interchangeability may be checked as described under that option. Data transfer is done a single sector at a time with complete error checking after each sector.

TEST G - This test performs a write/read across the entire disk using a worst-case data pattern (5B) for MFM double density recording as done by the 1793 controller chip. Diskette interchangeability may be checked, and complete error checking is done after each sector.

TEST H - This test will create a table of 100 random tracks and sectors, and fill each sector with 256 bytes of random data. After writing to all 100 tracks/sectors, they are read back in reverse order to insure that approaching the tracks from either direction will not cause data recovery problems. Ability to interchange diskettes may be checked, and error checking is done after each sector.

TEST S - This test checks the basic accuracy of the drive motor speed of the first requested drive. The results are continuously monitored and displayed on the screen. The allowable error is +/- 1 RPM from the nominal value of 300 RPM. Adjustments may be made while the test is running. To exit the test, hold down the "ENTER" key.

> ====> NOTE: ADJUSTING THE MOTOR SPEED IN THE MODEL 3 IS NOT AN EASY OR TRIVIAL TASK, SO, EVALUATE THE RESULTS OF THIS TEST IN CONJUNCTION WITH THE RESULTS OBTAINED DURING ACTUAL OPERATION! THE RADIO SHACK DISK CONTROLLER BOARD FOR THE MODEL 3 IS ABLE TO ACCOMODATE A FAIRLY WIDE VARIATION IN DRIVE MOTOR SPEED. IF A DRIVE APPEARS TO BE EITHER TOO FAST OR TOO SLOW, BUT RUNS ALL THE OTHER TESTS WITHOUT ERROR, LEAVE IT ALONE!!! ADJUSTMENT OF THE MODEL 3 DRIVES REQUIRES TOTAL DISASSEMBLY OF THE COMPUTER AND MAY VOID ANY AND ALL WARRANTIES PROVIDED BY TANDY CORP. IF YOU REALLY FEEL THAT YOUR DRIVE(S) REQUIRE ADJUSTMENT, AND YOU DO NOT WANT TO TACKLE THE JOB YOURSELF, TAKE THE SYSTEM IN TO RADIO SHACK OR OTHER COMPETENT TECHNICIAN FOR CHECKOUT! <====

TEST T - This is the Tech Test; it can be used for aligning and troubleshooting disk systems. It essentially allows you to use your Model 3 as an "intelligent" disk exerciser. Three functions are available: Write Sector, Read Sector, and Seek Track. The test is performed on the first requested drive.

You will be asked to specify the track and sector for the operation; these are each 2 hexadecimal digits. Please note that NO error checking is done on the

values entered; if you specify a non-existant or undefined track or sector, the program may bomb out on you. Also, leading zeroes MUST be entered -- for example, track 9 must be entered "09". If the Write function is selected, you will be asked to specify a 2-digit hex value to be written to the disk; this value will be used to fill the specified sector.

The Write and Read operations will be done with complete error checking; a continuously updated status display will be shown on the screen similar to this:

STATUS: 0W0XYZ00

This status is a "mask" of the 1793's Type II status byte and is read from left to right going from bit 7 to bit 0. The bits shown above as zeroes will always be zero. The four meaningful bits are:

W=1 -- WRITE PROTECT (during write op. only)
X=1 -- RECORD NOT FOUND error
Y=1 -- CRC error
Z=1 -- LOST DATA error

Bits equal to 0 mean no error occured. During a Write operation, "W"=1 means Write Protect is sensed and the write is not actually taking place. As an example of a status word, "00001000" indicates there is a CRC error.

When running the Tech Test, pressing "T" while the test is in progress will return you to the start of the test; entering " " (up-arrow) as the function code will return you to the main menu.

During the Seek function, the following sub-functions are available:

"R" - Restore and re-seek to previous track
"I" - Step head in one track
"O" - Step head out one track

During the seek operation, the current track will be displayed on the screen and will be updated as you step in or out. Note that if you step past the limits of the drive (for example, beyond the last track on the disk) this display may no longer be valid.

Pressing any other keys during the Tech Test will return you to the main program menu. Remember that all values must be entered as two hex digits, with leading zeroes!

ERROR HANDLING

Error messages are printed out any time the diagnostic detects error or abnormal conditions. Errors in certain tests are considered fatal and will cause immediate termination of testing. For example, if the track 0 switch is not working correctly, there is no point in running any other tests. Other errors will be reported by type, with track and sector information printed out in hexadecimal. During normal write and read operations, the errors you are likely to see are CRC ERROR, LOST DATA, RECORD NOT FOUND, and SEEK ERROR. The error summaries will tell you the accumulated number of these four types.

CRC ERROR - During a disk write operation, the controller will calculate a CRC byte (cyclic redundancy checkword - a sort of checksum) for each 256 byte record and write it to disk. When this record is read back in, the controller will again calculate the CRC byte and compare it to the one it recorded on the disk; if these two don't match, a CRC error occurs. These errors are most common on the inner (higher numbered) tracks. Possible causes of this error include flawed (or just not up to double density standards) diskettes or controller board problems with write precompensation or data separation.

LOST DATA ERROR - This error indicates that the CPU is not keeping up with the disk controller as it transfers data. This error is very rare, but a possible cause could be a problem with wait state generation or motor speed.

RECORD NOT FOUND - Whenever the controller is told to write or read a sector, it must first locate this sector on the disk using the track and sector information that was written on the diskette during formatting. If the controller is unable to find the specified track and sector within four revolutions of the disk, a Record Not Found error is declared.

SEEK ERROR - Indicates that the track information read from the disk at the completion of a seek operation did not match what the controller expected to find.

Other error messages are:

INDEX MARK NOT SENSED
INDEX MARK SENSED WHEN NOT EXPECTED
TRACK 0 NOT SENSED CORRECTLY
BUSY FLAG NOT SENSED WHEN EXPECTED
DRIVE EXCEEDED TIME LIMIT TO COMPLETE OPERATION
CONTROLLER CHIP TRACK REG. IS NOT BEING UPDATED
WRITE PROTECT NOT SENSED WHEN EXPECTED
WRITE PROTECT SENSED WHEN NOT EXPECTED
DRIVE SENSED NOT READY
DRIVE SENSED READY WHEN NOT SELECTED
FORCED LOST DATA ERROR DID NOT OCCUR WHEN EXPECTED
FORCED RCD NOT FND ERROR DID NOT OCCUR WHEN EXPECTED
CONTROLLER DOES NOT SENSE ANY DATA COMING FROM THE DRIVE
CONTROLLER DID NOT ISSUE END-OF-OPERATION INTERRUPT
CONTROLLER DID NOT ISSUE MOTOR TIMEOUT INTERRUPT
CONTROLLER WAIT STATE COUNTER NOT WORKING CORRECTLY
UNEXPECTED MOTOR TIMEOUT INTERRUPT
DATA READ FROM DISK IS INCORRECT (expected/actual data)

The Model 3 disk controller board is representative of state of the art design, and will function with excellent reliability when properly adjusted. The three adjustments required on the board are related to the phase lock loop data separator, and the write precompensation circuitry. UNDER NO CIRCUMSTANCES SHOULD YOU ATTEMPT TO MAKE THESE ADJUSTMENTS UNLESS YOU KNOW WHAT YOU ARE DOING AND HAVE THE PROPER TEST EQUIPMENT TO DO IT WITH!

BACKING UP THE MASTER DISK

It pains me greatly to tell you this, but the master program disk may be backed up using the Superzap CDS function (Copy Disk Sectors). The source and

destination drive PDRIVE entries must be set up with TI=AI (sector numbering starting at 1). Beginning with relative sector 0, copy the first 6 tracks (0 thru 5), or 108 sectors. You wouldn't copy it for your friends, would you? Of course not.



## MEMORY DIAGNOSTIC -- (C) 1981 BY DAVE STAMBAUGH FOR DRC

The Memory Diagnostic is a comprehensive test of the memory arrays. After the program loads, the user will be asked to enter test parameters as follows (be sure to remove the master disk from the system):

ENTER THE SYSTEM MEMORY SIZE? (1=16K, 2=32K, 3=48K) -- Enter the appropriate total memory size for your system. For example, if you have 32K you would enter "2".

PAUSE ON ERRORS? (Y OR N) -- If you want the diagnostic to pause whenever an error occurs, enter "Y". This would be useful whenever a great number of errors are occurring since they will scroll off the screen faster than you can read them. If no errors occur, or they are infrequent, you may want to specify "N". Whenever the test pauses after an error, you may resume testing by pressing "Y" to retain the pause-on-error mode of operation. Pressing any other key would disable this mode.

RUN M-1 WORM TEST? (Y OR N) -- It is recommended that you delay running this test until you are sure your system passes the normal write/read test without error. Because this test actually executes machine code from the memory being tested, results can be unpredictable sometimes. For details on this test, see the description which follows. Enter "Y" to run the test or "N" to suppress it.

The diagnostic will keep you informed at all times of what it is doing. During the write/read portion, it will alternately display "WRITE/READ" and "VERIFY" as it moves through these two sections. The "LOOP" count displayed will increment from 00 to FF. During the M-1 Worm Test, it will print out the execution address of a six-byte block of code and this address will increment to the top of memory in your system. The larger the memory, the longer the diagnostic will take to run. One complete pass on a 48K machine will take about 30 minutes. At the end of each complete pass, the total pass count and the cumulative error count will be displayed. The most desirable way to test your system for long-term reliability is to allow the diagnostic to run overnight as a minimum, and longer if possible. Many manufacturers of computer equipment "burn in" system for 72 hours or more, sometimes at elevated temperatures.

TEST DESCRIPTIONS

The Memory Diagnostic is broken down into two basic tests, the conventional write/read test and the M-1 Worm test.

WRITE/READ TEST -- This portion of the diagnostic performs a comprehensive check on the ability of each memory location to store and retain data. The test is broken down into 5 basic pattern tests. Each of these tests executes as follows: the address under test is written into and immediately read back to insure accuracy. This continues on through to the end of memory. Then each address is re-checked to insure 1) data integrity is maintained over a period of time (refresh) and 2) accessing any particular address did not alter data in any other address. One pass of the diagnostic will have tested each address 520 times using every possible data pattern.

M-1 WORM TEST -- This test is named for the Z-80 M-1 machine state (opcode fetch) which is the most critical in regard to memory timing and for the fact that the test "worms" its way through memory. This test attempts to execute a short block of machine code from the memory under test. First the entire test area is filled with "FF". Then a special 6-byte block of code is written into the first 6 locations and is executed. If this works, the 6-byte block will be moved up one address, the byte immediately preceding the block is changed to "FF", and the block is executed again. This continues, moving the block up one address each time, until it has moved throughout memory. Some Z-80 machines have problems running a test such as this due to timing problems since this is a worst-case situation for the CPU and memory.

ERROR HANDLING

Errors are handled differently depending on whether the write/read test failed or the M-1 Worm test failed.

ERRORS IN WRITE/READ TEST -- An error in this portion of the test will cause an error message to print out with the following information (all hexadecimal): the error address, the expected (correct) data, the actual (error) data, and the location of the failing IC. A typical error printout might be as follows:

```
ERROR: ADDRESS=A045  EXPECTED DATA=B5  ACTUAL DATA=BD
       DATA BIT(S):  7   6   5   4   3   2   1   0
       ---------------------------------------------
  ON MAIN PC BOARD:                U30
```

See the section on Troubleshooting Hints for help in interpreting error messages.

ERRORS IN M-1 WORM TEST -- Errors in this test can be much more difficult to handle because it attempts to actually execute machine code from the address under test. The results can be unpredictable if the machine attempts to execute an unexpected or non-valid instruction. This is the reason for filling all addresses with "FF" prior to execution of the test; if the CPU pulls the instruction from one of these address rather than the six we are actually trying to test, it would execute a RST 38H instruction which would turn control over to a ROM-based "trap" routine. If this occurs, or if any other

error occurs, an error message will appear such as this:

```
***** ERROR IN M-1 WORM TEST *****
ADDRESS OF 1ST BYTE OF CODE = ZZZZ
EXPECTED CODE AT TEST ADDRESS = 7D 55 AA C3 B6 44
ACTUAL CODE AT TEST ADDRESS   = XX XX XX XX XX XX
```

"ZZZZ" represents the address of the first byte of the six-byte block; "XX" would equal the actual code at the test addresses and may or may not match the expected data. If the system fails this test but will not print out any error messages (for example, it reboots or does something else unexpected) you could try running the write/read test alone for a long period.

TROUBLESHOOTING MEMORY PROBLEMS

It is not possible to document here every possible cause of memory problems in the computer; only the most common of these problems will be discussed. If the system fails the diagnostic, and you do not want to attempt to troubleshoot it yourself, write down the results of the diagnostic and take your system in for repair.

*** NOTE *** IF YOU OPEN THE COMPUTER CASE, YOU MAY VOID ANY AND ALL WARRANTIES FROM TANDY CORP!!!! THE MOS MEMORY CHIPS IN YOUR COMPUTER ARE VERY SENSITIVE TO STATIC ELECTRICITY, AND ARE EASILY DAMAGED BY IMPROPER HANDLING. IN ADDITION, GETTING AT THESE CHIPS REQUIRES TOTAL DISASSEMBLY OF THE COMPUTER, NOT A TRIVIAL TASK! KNOW WHAT YOU ARE GETTING INTO BEFORE YOU GET INTO IT!

For the purposes of this discussion, the computer contains three 16K memory arrays which will be referred to as "pages". The three pages of memory are addressed as follows:

PAGE 1 - ADDR X'4000' TO X'7FFF'
PAGE 2 - ADDR X'8000' TO X'BFFF'
PAGE 3 - ADDR X'C000' TO X'FFFF'

The IC's which make up these pages and the associated data bits are:

| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|
| PAGE 1 | U07 | U08 | U09 | U10 | U11 | U12 | U13 | U14 |
| PAGE 2 | U26 | U27 | U28 | U29 | U30 | U31 | U32 | U33 |
| PAGE 3 | U43 | U44 | U45 | U46 | U47 | U48 | U49 | U50 |

Using the error example given previously, the error address was X'A045', the expected data was "B5", and the actual data was "BD". In this case, the error occurred in Page 2 of memory; the actual data indicates that we picked up data bit 3.

| DATA BITS | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| "B5" = | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
| "BD" = | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |

From the charts, you can see that the memory chip for data bit 3 in Page 2 is U30 on the main CPU board. These reference designations are silkscreened on the circuit boards next to each chip. If this were the only bit failing, you could try swapping the suspect IC with another one. If the error moves to the new location, you have probably found the bad memory chip. If the error persists at the same location, or if you have multiple bad bits or cannot otherwise determine any other logical pattern to the errors occurring, you should probably take the unit in for repair.

Keep in mind that your system may fail even though there is nothing technically wrong with it. For example, if you are in an electrically "noisy" environment (such as an office with copying machines or other electrical equipment), the computer can pick up "glitches" from the AC line causing random errors. Another cause of problems is wide swings in the line voltage. For example, if the display on your video monitor is constantly shrinking and expanding, the line voltage may not be stable enough for the computer to handle. In either of the above situations, you may be forced to invest in some kind of power conditioning equipment before your computer will operate reliably.



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Please take the time to send in the following registration form. If something should happen to your master diskette which damages the software, we will re-copy the programs onto the diskette for a $5.00 charge for postage and handling. This offer applies to registered owners only, and may not apply if the diskette has been physically abused. When returning diskettes, provide adequate protection such as putting the diskette between 2 pieces of cardboard and mark the outside of the mailer "DO NOT BEND" in LARGE letters!

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# ADDITIONAL INSTRUCTIONS FOR MODEL III FLOPPY DOCTOR VERSION 2.0 ("SUPERDOC")

Version 2 of the Model III Floppy Doctor contains a number of enhancements designed to increase greatly the versatility of the program. Since some of these enhancements have altered the way the user may wish to respond to certain program parameters, it is recommended that you review these changes below prior to running the program.

1) The program will now handle drives of mixed tracks, heads, and stepping rates. This means, for example, that you could test a 40 track single sided drive and an 80 track double sided drive at the same time; you no longer need to test them separately. For each of the above three parameters, the user will enter a value for each drive being tested. For example, if you selected drives 0, 1, and 2 to be tested, you will enter 3 values for track count, number of heads, and stepping rate, corresponding to the correct values for the drives under test.

2) Line printer output of error reports and summaries is now supported. Answer the query "Line printer error output? (Y or N)" with "Y" to send reports to both the CRT and the parallel printer port; "N" to send reports only to the CRT. The ROM-based printer routines are used for all output except top of forms control which is maintained internally to try to retain compatibility with as many printers as possible.

3) New test (Test I) checks ability of the controller to properly format diskettes, thus eliminating the need for using pre-formatted diskettes. However, it should be understood by the user that the format operation utilizes almost all the controller's capabilities, so if you suspect that your system has problems, it is still recommended that you try to use pre-formatted diskettes and run Tests A-H in ascending order. When using diskettes in an unformatted or otherwise unknown state, Test I MUST be run first in order to get these diskettes into a known state. For example, to run all tests on a blank diskette, you might run tests IABCDEFGH.

4) The density-selection option now allows you to run in both single and double density ("Both"); the testing would switch between single and double density on alternate passes of the diagnostic. However, if selecting both, Test I again MUST be the first test run in order to insure that the diskettes are formatted to a known state.

5) Test S (Speed Test) now gives an absolute readout of drive motor speed by measuring the time between successive index pulses in milliseconds. The exact value for a drive spinning at precisely 300 RPM is 200 milliseconds; the actual measured value will probably vary slightly on each readout. This variation is normal and is not a matter to be concerned about unless the reading varies wildly.

6) Test B now measures the actual value of the wait state timeout counter and also the motor-on time. These values are calculated using the real time clock as a reference; therefore, it is necessary to calculate two values for each, one for 60 Hz systems and one for 50 Hz systems. Both values are printed out; ignore the value that does not apply to your system. For the standard Radio Shack disk controller board, the nominal value for the wait state counter is 1024 microseconds, and the motor-on time should be in the neighborhood of 2.5-3.5 seconds (longer is OK, shorter may cause problems).

7) Test G now uses a 3-byte worst case data pattern of 6D B6 DB.

8) Test D now checks the ability of the controller chip to properly generate both deleted and non-deleted data address marks.

9) When running double sided drives, and if Test I is selected, the controller chip's ability to properly generate side-compare information in header data is enabled during all subsequent testing. Failure of the side comparison bit will result in "Record Not Found" errors.

10) Track and sector information is now printed out in decimal rather than hexadecimal. Note, however, that this information must still be entered in hexadecimal in Test T.

11) Error totals may now total up to 9999; previous limit was 99 of any one type.

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